

## MEDICINAL PLANTS FROM THE HIGH ALTITUDES OF THE WESTERN PART OF ARUNACHAL PRADESH, INDIA AND THEIR TRADE

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### Abstract

*The tremendous medicinal plant resources of Northeast India are utilized by different agencies as raw materials and/or for direct application. No proper assessment of the resources and no investigation on the extent of exploitation has been performed so far, especially in the high altitudes of Arunachal Pradesh viz., West Kameng and Tawang. That state is the richest in biodiversity, with high value medicinal and aromatic plants, as well as rare and endangered species. The medicinal plant species used in the herbal industry today are mostly extracted from the wild areas and most of them come from the high altitudes of this region. The present study gives an account on some preliminary observations about the commercial medicinal plants from the higher altitudes of Arunachal Pradesh, some of which being of immense economic value.*

**Keywords:** medicinal plants; Arunachal Himalaya; *Taxus wallichiana*; *Illicium griffithii*;  
commercial prospect

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### Introduction

Our dependence on plant resources is well known since the early days in the evolution of mankind on earth. Medicinal plants are a living and irreparable resource, which is exhaustible if overused and sustainable if used with care and wisdom. The importance of medicinal plants was overlooked in the past. Nevertheless, at present, medicinal plants are looked upon not only as affordable health care, but also as a source of income. According to the WHO report, over 80% of the world population relies on traditional medicine, but that is largely plant-based for primary health care needs. This resource cannot remain sustainable in the future, because, on one hand forest cover is steadily shrinking and on the other, the requirement of medicinal plants and herbs is increasing very rapidly *day-by-day*. In order to conserve the gene pool of medicinal plant reserves, *ex-situ* conservation is very much needed. Habitat degradation, unscientific harvesting and over-exploitation to meet the demands of the illegal trade in medicinal plants, have led to the extinction of more than 150 plant species in the wild [1]. At least 90% of the plant species used in the herbal industry today is extracted from the wild, the majority of which come from the Himalayan region [1, 2]. It is believed that excessive anthropogenic pressures are the main cause of the decline in the population and availability of these medicinal plants in the Himalayan region [3, 4]. The use of plants as medicine is mentioned in the Rig-Veda and

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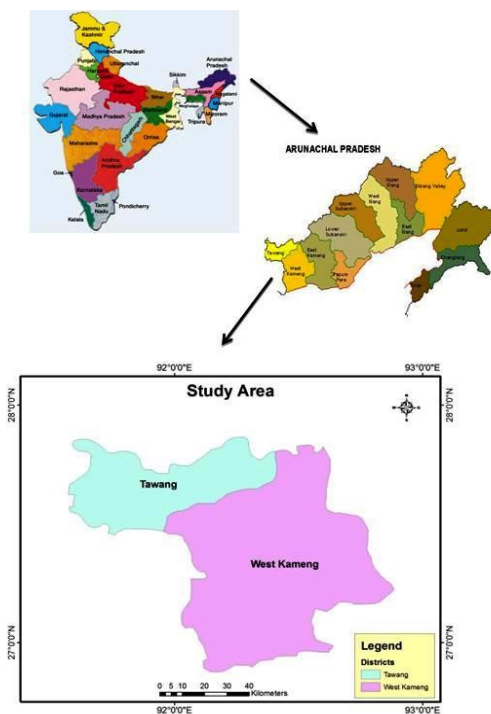
the Charak Samhita, which describes Himalaya as the best habitat for medicinal plants [5]. The Indian Himalayas support 1748 medicinal plants and many wild edible and fodder species [5, 6].

Arunachal Pradesh the ‘land of rising sun’ is situated in the extreme North Eastern Region of India. It extends between 91° 30’ - 97° 30’E longitude and 26° 28’ - 29° 30’N latitude, covering an area of 83,743 km<sup>2</sup>. That state is the richest in biodiversity in the whole country, housing high value medicinal and aromatic plants, as well as rare and endangered species of flora and fauna. There are over 500 known medicinal plant species reported so far in different locations of Arunachal Pradesh [7, 8]. The tribal people of Arunachal Pradesh have their own culture, tradition and medicinal system of treatment, with a practical and applied aspect of knowledge, acquired through a close observation of nature. However, in that state, very little work has been done on that aspect [7, 9-13] and most of the studies are confined to tropical plant species. The present study gives an account on our preliminary observations about the commercial medicinal plant species in the higher altitudes, which are of immense economic value.

**Materials and Methods**

*Study site*

The study was conducted in the West Kameng and Tawang districts of Arunachal Pradesh. West Kameng is located in the western part of Arunachal Pradesh, covering an area of 7,422km<sup>2</sup>. It is bordered by China in the north, the East Kameng district in the east and the Sonitpur district of Assam in the south and in the west by the Bhutan and Tawang districts of Arunachal Pradesh. Its coordinates are 26° 54’ - 8° 01’N latitude and 91° 30’ - 92° 40’E longitude. The district is mostly mountainous and a greater part of it falls within the higher mountain zone, consisting of mass tangled peaks and valleys (Fig. 1).



**Fig. 1.** Map showing the study area (West Kameng and Tawang) of Arunachal Pradesh, India.

The main river of the district is the Kameng River, with lots of seasonal and perennial streams and streamlets. The Tawang district, covering an area of 2172km<sup>2</sup>, lies between 27° 25' - 27° 52' N latitude and 91° 16' - 91° 59' E longitude. It is bordered by Tibet in the north, Bhutan in the southwest and the Sela ranges, separate from the West Kameng district, in the east. Two thirds of the entire area of the district consists of high mountains. There are two main rivers, namely Tawang-Chu and Nyamjang-Chu. The Tawang and West Kameng districts land use pattern and tenancy is based on the customary and traditional system of the state. The local people exercise traditional right over their land, which is held individually, commonly and based on clan, for agricultural purposes, such as jhuming, settled, terrace and wet rice cultivation. They also exercise their right over the land for traditional hunting, fishing, grazing and the extraction of forest products for domestic purposes. *Monpa* is the predominant community, inhabiting the high altitudes. The predominant vegetation in some of the areas of the West Kameng district is subtropical, broad-leaved and pine forests, evergreen and dense in nature. A few areas of Bomdila, Dirang and Tawang in Arunachal Pradesh exhibit temperate, broadleaved and temperate coniferous forests.

An extensive and intensive field survey was conducted during 2010-2011, to generate information on the plants used for medicinal purposes by the inhabitants of the two districts. During surveys, knowledgeable persons from the village were interviewed and information on local names, the parts used, etc. was gathered. The indigenous uses of the species are based on primary, as well as secondary data. The identification of plant species collected during field studies was done by consulting the floral herbarium of the Botanical Survey of India (Itanagar Unit), State Forest Research Institute and by consulting a number of flora monographs *viz.*, The Flora of British India, Vols. I-VII and Flora of Assam, Vols. I-IV [14, 15].

## Results and Discussion

We observed that many species were poorly represented in their original locations, either due to the disturbance of their habitats, or to excessive collection. If the current practices of human activities continue, even the unrecorded species of immense value will disappear. In a preliminary survey, 40 medicinal plants were encountered, from the different parts of the West Kameng and Tawang districts of Arunachal Pradesh, which were used by the local tribes in their daily ailment treatments, for curing various diseases and also to meet the demand of the market (Table 1). Out of those, 16 were trees, 7 shrubs and 17 herb species.

The region was not only a rich repository of medicinal plants, but it also nurtured several distinct ethno-medicinal systems over a long period of time. Among them, the most prominent was the Tibetan system of medicine. All those systems rely on the local plant resources. However, we should emphasize that this enumeration is by no means exhaustive and it includes only the common species that were verified through more than one source, *i.e.*, the traditional healers, medicine men, village head man (Gaon-buda) *etc.*

In the higher altitudes of Arunachal Pradesh, cattle grazing is one of the most destructive activity. The natural habitat of precious medicinal plants, such as *Aconitum*, *Picrorhiza*, *Nardostachys*, *Swertia* etc, is destroyed by grazing. Some of the ayurvedic companies of the country accelerate the obliteration of species of this region. These establishments pay money to the local people to make them indiscriminately collect the raw biomass of medicinal plants. Over-exploitation and continuous depletion of medicinal plants have not only affected their

supply and their genetic diversity, but they have also seriously affected the livelihood of the indigenous people living in the forest margins.

**Table 1.** Medicinal plant species availability and uses in the high altitudes of Arunachal Pradesh, India

Species	Vernacular name	Family	Habit	Uses
* <i>Aconitum ferox</i>	Bish	Ranunculaceae	Herb	Antipyretic, Rheumatism and Skin diseases
* <i>Acorus calamus</i>	Daruga/ Boch	Araceae	Herb	Carminative, General Tonic, Diarrhea & dysentery
<i>Argemone maxicana</i>	Kuhumkanta	Papaveraceae	Herb	Urinary track infection and liver disorders
* <i>Andrographis paniculata</i>	Kalmeg	Acanthaceae	Herb	General tonic, Fever, Worms, Dysentery and liver disorder
<i>Averrhoa carambola</i>	Kordoi	Averrhoaceae	Tree	Jaundice & Anaemia
<i>Bacopa monneri</i>	Brahmi	Scrophulariaceae	Herb	General tonic & Skin diseases
<i>Canabis sativa</i>	Bhang	Cannabaceae	Herb	Anthelmintic, Bronchitis & Piles
* <i>Cinnamomum bejolghota</i>	Chinchayong	Lauraceae	Tree	Liver disorders, Fever
* <i>Cinnamomum tamala</i>	Tejpat	Lauraceae	Tree	Carminative, Colic pain and Diarrhea
<i>Citrus medica</i>	Kaginemu	Rutaceae	Tree	Gastric and Tumors
<i>Citrus aurantium</i>	Pathinebu	Rutaceae	Tree	Laxative & Urinary tract infections
<i>Clerodendrum colebrookianum</i>	Bhati	Verbenaceae	Shrub	Blood pressure, Cough & Cold and Liver disorders
<i>Clerodendrum serratum</i>	-	Verbenaceae	Shrub	Fever
* <i>Coptis teeta</i>	Mishimiteeta	Ranunculaceae	Shrub	Cough & Cold, Diarrhea & Dysentery and any liver disorders
<i>Costus speciosus</i>	Kewpachla	Costaceae	Shrub	Piles and ear diseases
<i>Dillenia indica</i>	Autenga	Dilleniaceae	Tree	Hair tonic & Dysentery
<i>Fagopyrum dibotrys</i>	-	Polygonaceae	Herb	Fracture and Skin diseases
<i>Fagopyrum esculentum</i>	-	Polygonaceae	Herb	Rheumatic pain & Fever
<i>Costus variegata</i>	Kewpachla	Costaceae	Herb	Ear diseases
<i>Garcinia pedunculata</i>	Kaw	Clusiaceae	Tree	Diarrhoea and dysentery
<i>Hedychium spicatum</i>	Banhaldi	Zingiberaceae	Herb	Asthma & Blood dysentery
* <i>Hydnocarpus kurzii</i>	Kutki	Flacourtiaceae	Tree	Skin diseases & General tonic
* <i>Illicium griffithii</i>	Domlishi	Magnoliaceae	Tree	Stimulant and Carminative
<i>Juglans regia</i>	Akrot	Juglandaceae	Tree	Anthelmintic & Rheumatism
* <i>Nardostachys jatamansi</i>	Jatamansi	Velerianaceae	Herb	Female disorders, Urinary tract infection and Indigestion
<i>Oroxylum indicum</i>	Bhatghila	Bignoniaceae	Tree	Hair tonic, anti-helminthic and carminative
<i>Oxalis corniculata</i>	Dhundi	Oxalidsaceae	Herb	Wormicide and liver tonic
<i>Osbeckia glauca</i>	-	Melastomaceae	Shrub	Liver disorders
<i>Polygonum chinense</i>	-	Polygonaceae	Herb	Malarial fever
<i>Polygonum rumicifolium</i>	-	Polygonaceae	Herb	Pain killer and Liver disorders
<i>Podophyllum hexandrum</i>	-	Podophyllaceae	Herb	Stimulant, Purgative & Stomach disorders.
<i>Potentilla lineata</i>	-	Rosaceae	Herb	Toothache and Diarrhoea
<i>Rhododendron arboretum</i>	Zingnangsing	Ericaceae	Tree	Diarrhoea & Dysentery
<i>Rubia cordifolia</i>	Manjista	Rubiaceae	Tree	To check vomiting, female disorders
* <i>Swertia chirata</i>	Chirata	Gentianaceae	Shrub	General tonic, stomachic, Chronic fever, bronchial asthma and liver trouble
* <i>Taxus wallichiana</i>	Teyshing	Taxaceae	Tree	Wood for house construction
<i>Terminalia bellerica</i>	Bohera	Combretaceae	Tree	Indigestion, liver disorders, and urinary troubles
<i>Terminalia chebula</i>	Harra/ Hilika	Combretaceae	Tree	Purgative, skin ulcer, cardio tonic, tooth ache and asthma in children's
<i>Tinospora cordifolia</i>	Hogunilota	Menispermaceae	Herb	Anaemia and urinary troubles
<i>Zanthoxylum oxyphyllum</i>	Gagra	Rutaceae	Shrub	Liver tonic

\*Commercially exploited plant

The trade of medicinal plants, from the high altitudes of Arunachal Pradesh to the neighboring states and industrialized nations, is growing at a tremendous rate for their use as pharmaceutical compounds, as well as for cosmetics and other household products. India's Ayurvedic industry and other medicinal plant markets, rooted in the ancient medical systems, use hundreds of tons of raw materials from the Himalayas each year. These mountains carry complex ecosystems, which are related to altitude and intricate local variations in the environment. The great diversity of vegetation types in the West Kameng and Tawang districts includes conifer forest at lower altitudes, sub-alpine and alpine communities, above the tree line. In the shadow of high mountain ranges, away from the reach of the monsoon, arid lands support vast areas of trans-Himalayan steppes. A large variety of medicinal plants thrive in these highly diverse habitats. Medicinal plants used locally, or subject to trade, often grow in microhabitats and many of them are perennial herbs, with slow growing rhizomes. They are vulnerable to over harvesting; the rates of extraction of such species should be regulated carefully. The results showed the immense knowledge of the Monpa, Sherdupkens and other Tibetan tribes of Arunachal Pradesh, who use hundreds of plants. Many more plants are still waiting to be identified. About 10 species from the region were in trading in large quantities and they include Jatamansi (*Nardostachys jatamansi*), Kutki (*Hydnocarpus kurzii*), Bish (*Aconitum ferox*), Mishimiteeta (*Coptis teeta*), Lichi (*Illicium griffithii*), Boch (*Acorus calamus*), Kalmeg (*Andrographis paniculata*), Dalchini (*Cinnamomum bejolghota*), Tejpat (*Cinnamomum tamala*), Teyshing (*Taxus wallichiana*). Presently, many of those species are under threat, due to their over-exploitation in the region.

### ***Illicium griffithii* in Arunachal Himalaya**

*Illicium griffithii* is commonly known as a *Lissi* and it is called *Munsheng* (Monpa) in West Kameng and Tawang. The species has been categorized as critically endangered in Meghalaya, yet not threatened in Arunachal Pradesh (Fig. 2a) [16]. It bears star shaped fruits that emit a characteristic, refreshing flavor (Fig. 2b). Dried seed and fruits/pods are the economically valuable part of *Illicium griffithii*, by having a good commercial market potential for spices and pharmaceutical purposes. The local people reported that *Illicium griffithii* bears fruits once a year in alternating cycles of one good productive year followed by a year of poor production. The species was also extracted for poles used for house construction, fences, in the garden, for agriculture lands etc. We observed that fresh leaves, in combination with juniper/thuja/pine leaves are burnt by the Memba tribe in Mechuka Valley, in a place called *Sangbumb*, to produce a smoke that is believed to be sacred and to help in purifying the surrounding air. The fruits of the species were used for medicinal purposes, because of their content of anethol-rich essences. It was reported that fruits were used as a carminative, stimulant, for stomachic, glactagogic, abdominal pain, dyspepsia, food poisoning, vomiting etc. [17-19]. The oil of the *Illicium griffithii* fruits has antifungal effects and can be used as an antifungal agent and food preservative [20].

*Illicium griffithii* has become a natural off-farm income resource. The collection and selling of medicinal and aromatic plants, plant parts/products, animal, animal products and also other non timber forest products are the main income source of the rural people in many parts of the region. Due to its high demand in the spice and pharmaceutical industry, local people

harvest huge quantities of *Illicium griffithii* fruits (Fig. 2c) during October to December each and every year, from different parts of the West Kameng district, such as Barchi, Bomdila, Chander, Dibin, Duwangba, Senge, Shergaon, Yewang and many other places. The collected fruits are dried and sold on the market. In a recent survey, they observed that the villagers are selling the dried fruits at a rate ranging from Rs. 120 to 150 per kilogram, which varies according to market demand. Dried seed pods/carples of *Illicium griffithii* serve as a natural off-farm income for the rural people of western Arunachal Pradesh, although it is an annual income. Therefore, *Illicium griffithii* may have the potential to reduce the poverty and provide employment opportunities to the rural inhabitants, which may contribute to the socio-economic development of that rural area.

#### ***Taxus Wallichiana* in Arunachal Himalaya**

It is locally called ‘*Teyshing*’, by the Monpa tribe of Bomdila and Tawang of West Kameng and Tawang districts and the Memba tribe of Mechuka of West Siang. However, the species is called as *Kitongmashing* by the Dirang and Senge Monpa of West Kameng. Local people reported that the leaves of the species have a good nutritious value and are used as fodder for the hill cattle and yak, which in turn provide the strength and power of the livestock. *Taxus Wallichiana* (Himalayan Yew) is a medium size tree and it is shade tolerant (Fig. 2d).



**Fig. 2.** *Illicium griffithii* (a) in natural habitat (b) dry fruits (c) author (J. Kalita) collecting fruit during field study (Oct-Nov, 2011); *Taxus wallichiana* (d) a medium sized tree (e) seedling in natural habitat (f) fleshy aril/fruit with seed.

The species have peeling bark with varied color, reddish or purplish, grayish brown, strips, or cracking and falling off as thin strips. It flowers during March to May and fruiting occurs during October to November [10]. Wind pollinated, its seed is dispersed by birds and mammals [21]. Seed germination is poor in the species. However, we have found a few naturally occurring seedlings (Fig. 2e). Fruits have a red fleshy aril, with a single nut like seed, enclosed within a cupular aril with the apex exposed (Fig. 2f). It has also been observed that the species is sparsely distributed. *Taxus wallichiana* associates with other broad leaved trees, such as *Acer* spp., *Castanopsis* sp., *Cinnamomum* sp., *Illicium griffithii*, *Michelia* sp., *Quercus* sp., *Rhododendron arizelum*, *Rhododendron grande*, *Rhododendron kenderickii*, *Rhododendron* sp. etc. and also with other conifer species, such as *Abies* spp., *Pinus wallichiana* etc. The natural populations of *Taxus wallichiana* grows in harsh conditions, because of anthropogenic activities. Very limited populations, with scanty individuals, are still surviving in a few locations and are under the threat to be wiped out from those locations in the near future, if the proper measures are not initiated.

#### ***Management, Conservation and Prospect of Medicinal Plants in the Region***

The recent shift to herbal medicines and the increasing demand for natural products resulted in a growing dependence on forests, as a rich source of those herbal products. However, due to unorganized exploitation, most of those species are either degenerating or under threat from the external environment. In the context of Arunachal Pradesh, deforestation and the extraction for fuel-wood, as well as poles for house construction and fences created a pressure on the *Illicium griffithii* and *Taxus wallichiana*. (Fig. 3a, b and c). The majority of the herbs are largely extracted by destructive harvesting. This aspect is very critical, not only for their sustainable regeneration as a resource in the long run, but also for the ecological stability of the ecosystem. Collectors of medicinal plants are usually greedy and are not aware of the scientific methods of harvesting. Research institutions can play a major role in creating the awareness amongst the collectors, as well as the forest staff, by supplying scientific information on how to harvest different species on a non-destructive basis. The local people are quite familiar with the identification of various important medicinal and other plants existing in the area. This knowledge of the local tribal communities can be used in training the forest staff to effectively manage and to prevent the loss of these vital resources from the areas, caused by unauthorized agencies or individuals. The local communities, especially those living in and around the forest areas, have an adequate knowledge of how to maintain the ecosystem on a sustainable basis. This traditional knowledge treasure could be effectively made use of by the forest managers, policy makers, ecologists and conservationists, in ensuring an ecological sustainability of the ecosystem and in planning the wise use of the resources in the interest of the communities and with their involvement in forest management simultaneously.

We should become aware that forest products, like medicinal plants, need to deliver goods and services not only for the national development, but should also concentrate on the needs of the poor forest dwellers. Researches should be targeted on the farmer level, so that they can address the needs of the poor. Researches into understanding the interaction between the rural people and the forests should emphasize the need to involve the local people in forest management.



**Fig. 3.** *Illicium griffithii* (a) left-out twigs (b) new cut stump (c) extracted wood for house making.

As with most of the medicinal plants, the rhizomes or roots are used. Hence, the entire plant is dug out, which has a negative impact on their biomass and regeneration in the wild. Besides, overgrazing by yak and goat has also degraded their habitats in many places. If similar trends exist in the present area, it is likely that the many species of economical and ecological importance decline more rapidly. Thus, to conserve the species-specific conservation, points should be marked in the wild, and any extraction or exploitation from those points should be banned. Their cultivation/propagation techniques should be promoted on a priority basis for all the species. Local people should be made more aware of both *in-situ* and *ex-situ* conservation measures, which are essential to maintain the rich, valuable biodiversity of the region. Hence, mass awareness regarding the high medicinal, economic importance and the motivation of local people for large scale cultivation in natural habitats, as well as domestication of the species, will not only increase the income generation but will also meet the market demand, as well as the conservation of the species.

## Conclusions

The demand for medicinal plants is ever increasing, as people are more fascinated by herbal medicine. The scientific, large-scale cultivation of commercially important medicinal plants may open up avenues for the income of the rural people. Thus, the systematic and organized cultivation of medicinal plants and the creation of processing and efficient marketing channels may boost the economic development of this tribal state.

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